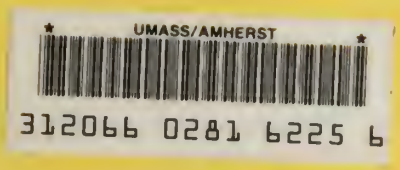

CTPS

HANSCOM AREA TRAFFIC STUDY

EXECUTIVE SUMMARY

JULY 1984

HANSCOM AREA TRAFFIC STUDY

Executive Summary
of
CTPS Technical Report 44

This document was prepared by **CENTRAL TRANSPORTATION PLANNING STAFF**, an interagency transportation planning staff created and directed by the Metropolitan Planning Organization, consisting of the member agencies.

Executive Office of Transportation and Construction
Massachusetts Bay Transportation Authority
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MBTA Advisory Board
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Metropolitan Area Planning Council

PREPARED FOR THE BENEFIT AND USE OF THE MUNICIPALITIES CONSTITUTING THE BOSTON METROPOLITAN AREA PLANNING DISTRICT

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S.1 SUMMARY

The Hanscom Area Traffic Study was undertaken to address both present and anticipated traffic problems in a designated area, referred to here as the Traffic Impact Area, adjacent to Hanscom Air Field. These traffic problems have been fostered, at least in part, by the substantial employment growth that has occurred in the vicinity. They are also associated with the location of the Traffic Impact Area between two major radial corridors to Boston, served by Route 2 and Route 3, near the point where these two routes join the circumferential corridor served by Route 128. This has resulted and will continue to result in daily waves of commuters traveling through the area. The combination of traffic to, from, and through the area, carried over relatively low-capacity town roads, has resulted in serious traffic-congestion and safety problems.

The following observations concerning existing conditions have been made during the course of this study:

- Congestion problems occur throughout the Traffic Impact Area, but are most pronounced along Route 2, Routes 4/225, and Hartwell Avenue, and within the town centers of Bedford and Concord.

- Safety problems are most pronounced at the Route 2 intersections of Bedford Road (Lincoln) and Crosby's Corner. Routes 4/225 in Lexington and Bedford and Hartwell Avenue in Lexington also stand out as roadways suffering from severe safety problems. Safety problems on these roadways occur not only at intersections but along the two roadways themselves.

The Hanscom area is expected to continue its employment growth in the future. As a means of addressing the already existing traffic problems and the problems associated with further growth, the study undertook an investigation of three proposed alignments of a ring road around Hanscom Field. This proposed road would connect Route 2 on the west and Hartwell Avenue on the east. The following conclusions have grown out of the study:

- Without substantial roadway improvements, future traffic congestion in the Traffic Impact Area will reach unacceptable levels.

- No Ring Road by itself could solve the area's traffic problems. Only by also upgrading Route 2 to expressway standards and by building a Hartwell Avenue connector to Route 128 could traffic conditions be brought to acceptable levels throughout the roadway system.

- Because of spill-over effects from the congested Route 3 corridor to the immediate north, improvements should be pursued in this corridor, specifically to Route 3 itself, before undertaking the construction of a Ring Road. Without this relief being provided in the Route 3 corridor, the benefits of a ring road to Route 4/225 traffic are quickly lost due to diverted traffic from Route 3.

S.2 BACKGROUND

The general area surrounding Hanscom Field has long been recognized as suffering from severe transportation-related problems, particularly during the morning and afternoon commuting periods. Geography has played a major role: this area, located within the communities of Bedford, Concord, Lexington, and Lincoln, lies between two major radial access corridors to Boston (served by Route 2 and Route 3) at a point just to the west of where these routes join the major circumferential corridor served by Routes I-95/128. In addition, the amount of land occupied by Hanscom itself has served as a physical barrier to the development of the arterial highway system.

Over time, this area has developed into one of the largest suburban employment centers in metropolitan Boston. The combination of commuter traffic to the industrial sites ringing Hanscom and commuter through-traffic has led to the buildup of significant traffic congestion on the relatively low-capacity arterial street system. A more detailed summary of existing conditions is provided in section S.6.

In order to attempt to relieve traffic congestion, several projects, dating as far back as 1964, have been proposed. Recurrent among these is a circumferential, or ring road, around Hanscom Field. It is hypothesized that such a road, by linking the major industrial sites surrounding Hanscom, would divert industry-related traffic from the congested arterial street system in the area. Prior to the current study, however, this ring road concept had not been subjected to vigorous analysis.

The Hanscom Area Traffic Study Committee (HATS Committee) was formed to address the area's traffic problems. Officials from the towns of Bedford, Concord, Lexington, and Lincoln joined with Massport (the operator of the civilian activities at Hanscom) and the Hanscom Air Force Base to commission a study aimed at mitigating existing and future traffic problems. Transportation concerns for the future included accommodation of anticipated growth in employment.

The specific purpose of this report is to analyze a set of alternative roadway networks developed by the HATS Committee. In the course of this study, CTPS found it advisable to re-format the HATS Committee alternatives and to analyze two additional

alternatives, as explained in section S.4. None of the alternatives attempts to address every transportation problem in the area. Impacts related to the alternatives are summarized in section S.5. For convenience, a summary of conclusions and recommendations is being presented immediately below, in section S.3.

S.3 CONCLUSIONS AND RECOMMENDATIONS

A significant increase in morning and afternoon peak-period traffic to, from, and through the Traffic Impact Area is forecast to occur by 1995. Given the current peak period travel conditions--in which significant levels of congestion and delay are already in evidence--traffic increases of the order projected to result from anticipated development will cause further widespread breakdowns of service along key segments of the existing highway system during peak periods. Put simply, the existing highway network will not be capable of adequately functioning during peak periods of travel, if an increase in traffic of the projected magnitude should occur.

Implementing the proposed Ring Road, in any of the tested alignments, as the only major improvement cannot restore projected traffic conditions to even those of the present on an areawide basis. And while the Ring Road does offer improved travel conditions on some segments of the highway system, most notably Route 62 through Concord and West Bedford, it also has the potential to cause increased congestion and delay over several roadways that lead traffic to or from it.

Only in the case of coupling the Ring Road with all the other major improvements included in Package 4* are future travel conditions restored to, or somewhat improved over, those of the present on a majority of the roadway segments. Yet due to the significant amount of new construction included in Package 4, it is doubtful that a substantial portion of these improvements could be in place by 1995.

The ring road alternatives proposed by the HATS Committee, included in packages 1, 2, and 3, successfully address some traffic problems, but have no effect on others. All of these ring road alignments will reduce traffic, and thus congestion and delay, along Route 62 from Concord Center to Bedford Center, with Package 1 providing the most relief and Package 3 the least. To a lesser degree, the Ring Road in all three packages will also reduce traffic congestion along Route 2A (North Great Road in Lincoln) east of Crosby's Corner.

Depending upon the alignment, varying amounts of traffic are forecast to be diverted away from Routes 4/225 (Great Road in Bedford) to the Ring Road. The northernmost alignment, along the abandoned Boston and Maine Railroad right-of-way, attracts the most trips from Routes 4/225, and the southernmost, along the

*See section S.4 for a description of the alternative roadway networks.

northern Massport property line, attracts the least. However, whatever traffic is attracted from this section of Routes 4/225 to any ring road alignment is quickly replaced, primarily by spill-over traffic seeking an alternative to the congested conditions in the Route 3 corridor to the immediate north. Since the ring road alternatives proposed by the HATS Committee all terminate at Hartwell Avenue in Lexington at one end and at Route 2 at Crosby's Corner at the other, traffic on these facilities in the vicinity of these termination points is increased. This is especially true for Route 2 to the west.

For the alternative packages developed by CTPS somewhat different findings were obtained. The major build alternative, Package 4, which includes not only the Ring Road but also such projects as the proposed Hartwell Avenue Connector and the northern alignment of the Route 2 Expressway*, does far more towards providing relief from area-wide traffic problems. In addition to the relief associated with the Ring Road, significant reductions in congestion on Route 2 and in the Hartwell Avenue/Bedford Street/Route 128 interchange area are forecast to occur with this alternative. These added benefits, however, are more related to the improvements to Route 2 and to the Hartwell Avenue Connector than to the Ring Road.

The partial ring road alternative, contained in Package 5, that has the Ring Road begin at Virginia Road rather than at Crosby's Corner, does not provide the traffic benefits associated with a full ring road alignment. Not only are the traffic conditions along Route 2, Route 2A, Routes 4/225, and Hartwell Avenue not improved, but traffic through Concord along Route 62 to Virginia Road is increased.

The following courses of action should be adopted by the HATS Committee to address the problems that have been identified.

Bedford Center/Route 4 and Route 225

In order to reduce traffic congestion through Bedford Center along the Great Road (Routes 4/225), the first course of action that should be undertaken is to secure traffic improvements in the Route 3 corridor to the immediate north, most importantly to Route 3 itself. Unless steps are taken to reduce the congestion and delays in the Route 3 corridor, whatever benefits that arise from a ring road, or any other improvement, will be quickly lost to traffic seeking an alternative to the congested conditions in that corridor.

Hartwell Avenue Area

The current projects for improving Hartwell Avenue, especially the intersection with Routes 4/225, and the widening of Great Road (Routes 4/225) in selected locations should be pressed

*While tested in its proposed "northern alignment", the conclusions concerning the benefits derived from the upgrading of Route 2 to limited-access expressway standards would be essentially the same regardless of its exact alignment.

forward vigorously. All of the ring road alternatives will cause some increase in traffic in this area, which is located at the northeastern terminus of that proposed roadway. Only through the construction of a Hartwell Avenue Connector, which would carry traffic directly onto Route 128, can significant relief from congestion and delay be provided to this area. It might be well to incorporate the Hartwell Avenue Connector as an extension of the proposed Ring Road in order to provide a package capable of alleviating both existing and future problems in this area.

Route 2 (Concord and Lincoln)

The proposed Ring Road will provide virtually no relief to either existing or projected problems along Route 2. In fact, traffic congestion on Route 2 west of the Crosby's Corner intersection, which is also the southwestern terminus of the Ring Road in its full alignment, is exacerbated by traffic accessing and egressing the ring road. Based upon the analysis of Package 4, the Route 2 problems appear to be solvable only through an upgrading of Route 2 to expressway standards. This finding is consistent with a similar finding recently developed by the North Lincoln Study Committee.

Route 2A (Lincoln and Lexington)

The proposed Ring Road in its full alignment will provide relief to portions of Route 2A through Lincoln. The most relief would be provided to the western section that lies between the intersection with the Cambridge Turnpike Cutoff and Bedford Road. The eastern section, between Airport Road and the Route 128 interchange in Lexington, would continue to be heavily congested under all of the packages, even Package 4.

Concord Center and West Bedford/Route 62

This area would derive major reductions in traffic congestion from the Ring Road, if the Ring Road commences at Route 2 (Crosby's Corner) rather than at Virginia Road. This full alignment for the Ring Road is only possible if a crossing of the Minute Man National Historic Park (MMNHP) is made. For costing purposes, it has been assumed that such a crossing would be accomplished by a tunnel under MMNHP property. However, the projected cost of that tunnel is so great ($11 million) that funding for the full Ring Road would be extremely difficult to obtain. If the Ring Road is to be further pursued, it is recommended that negotiations be undertaken with the National Park Service in order to determine if some less costly option, such as depressing the Ring Road through MMNHP, might be acceptable. It should be noted that substantial traffic flow improvements in the Concord Center area could be obtained by the upgrading of Route 2 to expressway status within Concord. If it were ever to come to a choice between an upgrading of Route 2 and a ring road in any alignment, it would be more prudent to choose the upgrading rather than the Ring Road.

Virginia Road (Lincoln)

Traffic is expected to increase on Virginia Road in Lincoln under all of the alternatives studied. The development planned for this area would cause increases in any case, but all of the ring road alternatives increase traffic on this road even further, turning this rural road into a major collector road. This changed status has significant implications for the substandard intersection of Virginia Road and Old Bedford Road. In order to avoid potential problems, the new roadway proposed by the HATS Committee (HATS Alternative 1), should be pursued. It appears to be warranted by current growth alone, and if the Ring Road is constructed or if plans for an office park in North Lincoln are implemented, this upgrade will become essential.

Ring Road (Concord and Bedford)

If a ring road alternative is to be further pursued, it is recommended that it be a full alignment one. While the environmental impacts and overall costs are substantially less for an alignment with its southwestern terminus at Virginia Road, the reduction in positive traffic impacts associated with this alignment negates most of its usefulness. Of the three ring road alternatives with full alignments, the northernmost, via the Boston and Maine right-of-way, and the southernmost, along the northern Massport property line, appear to be the two from which to choose. The northern alignment, as contained in Package 1, provides the greatest level of traffic benefits, but also causes the largest number of negative environmental impacts.

S.4 THE ALTERNATIVE HIGHWAY-NETWORK PACKAGES

The HATS Committee developed four alternatives, which CTPS, in the course of analysis, found it advisable to formulate into three packages. Because HATS-Committee Alternative 1 would have only localized traffic impacts, it was combined with HATS-Committee alternatives 2, 3, and 4, respectively, to create packages 1, 2, and 3. CTPS also found it advisable, upon consideration of interim findings of this study, to formulate and analyse two additional packages, 4 and 5. Package 4 was developed because it became apparent that none of the HATS-Committee alternatives could deal effectively with the estimated 1995 travel demand. Package 5 was developed because it became apparent that the crossing of Minute Man National Historic Park presents serious difficulties.

The four HATS-Committee alternatives and packages 4 and 5 are described in the following sections.

Alternative 1

"A relocation of Virginia Road (to above the bluff) linked with Old Bedford Road."

This alternative has been taken to be a short (approximately one-third mile) segment of road commencing at a point on Old Bedford Road in Lincoln just to the west of the Hanscom Drive intersection. The roadway segment proceeds westward above the bluff to an at-grade intersection with Virginia Road in Lincoln at a point roughly halfway between the current intersection with Old Bedford Road and the Concord town line.

Alternative 2

"The construction of a ring road from the Route 2/Route 2A intersection to the Route 62 area through Bedford (via the rail bed)."

This alternative has been taken to be a four-lane, undivided roadway with at-grade intersections, constructed over a new right-of-way, commencing at the Route 2/Route 2A intersection (Crosby's Corner) in Concord and proceeding generally northward through Concord. At Lexington Road, this Ring Road tunnels under the Minute Man National Historic Park, with no traffic access to Lexington Road. Continuing northward from this point, the Ring Road intersects Virginia Road at-grade at a point to the west of

Elm Brook in Concord. From this intersection with Virginia Road, the roadway proceeds further northward into Bedford until reaching the existing Boston and Maine Railroad's abandoned Concord Branch right-of-way. It then follows the railroad right-of-way in Bedford, intersecting Hartwell Road and South Road at-grade. At a point just to the east of the South Road intersection, the Ring Road leaves the rail alignment and proceeds eastward over a new right-of-way to a connection with Wiggins Avenue. From this point, it proceeds southward over the existing Wiggins Avenue right-of-way until reaching the present Summer Street intersection. This section of the proposed Ring Road is, in essence, an upgrading of the existing Wiggins Avenue facility. The Ring Road then proceeds further southward over a new right-of-way as an extension of the present Wiggins Avenue until reaching the vicinity of the northeast corner of the Massport property line. From this point, it proceeds in a generally southeasterly direction into the Town of Lexington until reaching its terminus at an at-grade intersection with the existing Hartwell Avenue.

Alternative 3

"A road running near the Raytheon property, then cutting through the Bedford Town Forest to Wiggins Avenue."

This alternative has been taken to be a four-lane, undivided roadway with at-grade intersections, constructed over new right-of-way, commencing at the Route 2/Route 2A intersection (Crosby's Corner) in Concord and proceeding in a generally northerly direction through Concord as described in Alternative 2, above, tunneling under Minute Man National Historic Park (MMNHP). Upon entering the Town of Bedford, this Ring Road proceeds in an easterly direction toward the present Raytheon site, until reaching the existing Hartwell Road right-of-way at a point southeast of the site. From this point, it proceeds generally eastward over the Hartwell Road right-of-way (replacing the existing Hartwell Road) to a point near the westernmost edge of the Bedford Town Forest. The Ring Road then leaves the Hartwell Road right-of-way and proceeds in a generally southeasterly direction, over a new right-of-way, until intersecting with South Road in the vicinity of the existing South Road/Summer Street intersection (which is maintained). From this point, the Ring Road runs over the existing Summer Street (Bedford) and Maguire Road (Lexington) rights-of-way until reaching its terminus at an at-grade intersection with Hartwell Avenue in Lexington. In essence, this segment of the Ring Road is an upgraded version of the existing Summer Street and Maguire Road facilities, which are replaced by it.

It is also assumed in Alternative 3 that the portion of the existing Hartwell Road in Bedford to the east of where the Ring Road enters the Bedford Town Forest ends in a cul-de-sac. Thus,

no traffic interchange between the proposed Ring Road and the easterly segment of Hartwell Road is possible.

Alternative 4

"An alignment that follows the northern boundary of the Massport property to Hartwell Avenue."

This alternative has been taken to be a four-lane, undivided roadway with at-grade intersections, constructed over a new right-of-way, commencing at the Route 2/Route 2A intersection (Crosby's Corner) in Concord and proceeding in the same alignment through Concord and Bedford as the Ring Road in Alternative 3, above (including a tunnel under MMNHP), until it reaches the vicinity of the Bedford Town Forest. From the point where this Ring Road leaves the existing Hartwell Road right-of-way, it proceeds over a new right-of-way in a generally southerly and then southeasterly direction along the northern boundary of the Massport property until reaching its terminus at an at-grade intersection with Hartwell Avenue in Lexington.

It is assumed that, in order to provide access between Wiggins Avenue and the Ring Road, Wiggins Avenue is extended southward, over a new right-of-way, to form an at-grade intersection with the Ring Road. This intersection would occur at approximately the Bedford/Lexington town line.

It is also assumed that the portion of the existing Hartwell Road in Bedford to the east of the proposed Ring Road ends in a cul-de-sac, as in Alternative 3. It is further assumed that the portion of the existing South Road in Bedford to the east of the proposed Ring Road also ends in a cul-de-sac. Thus, no direct traffic interchange between the proposed Ring Road and either the easterly segment of Hartwell Road or South Road is possible.

Package 4

This package has been structured to include all of the reasonable major projects that have been proposed up to the present time for the study area including a Ring Road, in order to test their combined ability to handle the projected 1995 travel demand. Incorporated in Package 4 are the following major elements (only the Ring Road is included in other packages):

- The proposed Ring Road, in its Package 3 alignment, including the tunnel under MMNHP (Package 3 is incorporated in toto).

- An upgraded Route 2 in Concord and Lincoln. This upgrading is assumed to extend from the vicinity of the existing Concord Rotary in Concord to the existing Route 2/Route 128 interchange in Lexington*. The facility would

*In actuality, the upgrading of Route 2 is proposed to extend further westward, to the vicinity of Kelly Corner in Acton. It was not deemed necessary to model the upgrading this far beyond the Traffic Impact Area.

be located on the existing Route 2 right-of-way in Concord and on a new right-of-way (the so-called Northern Alignment) in Lincoln (the existing Route 2 facility in Lincoln would remain as it is). The highway is assumed to be four-lane (two lanes in each direction), median-divided, grade-separated, and fully access-controlled throughout its length. Access via either direct interchange or service roadways to adjacent interchanges is assumed for seven Concord roadways--Elm Street, Main Street (Route 62), Nine Acre Corner Road, Sudbury Road, Walden Street (Route 126), Sandy Pond Road, and the Cambridge Turnpike (existing Route 2)--and for two Lincoln roadways--the proposed Ring Road and the proposed Hanscom Drive Connector.

- The closure to general traffic of Route 2A (throughout the length of Minute Man National Historic Park) from the existing intersection of Old Bedford Road and Lexington Road (Merriam's Corner) in Concord to the existing intersection of Airport Road and Massachusetts Avenue in Lexington.

- Extension of the existing Hanscom Drive over a new right-of-way, from its current southern terminus at North Great Road (Route 2A), in a southeasterly direction to an at-grade intersection with a Connector Road to the upgraded Route 2 Expressway and to Massachusetts Avenue.

- Construction of a Connector Road on a new right-of-way linking Massachusetts Avenue on the north with the upgraded Route 2 Expressway on the south. The Connector Road would have an at-grade intersection with Massachusetts Avenue in Lexington and with Mill Street and Hanscom Drive (extended) in Lincoln. It would also have a diamond-type grade-separated interchange with the Route 2 Expressway.

- Construction of a Hartwell Avenue Connector from the intersection of the Ring Road and Hartwell Avenue to Route 128 in Lexington. For the present systems analysis, the connection with Route 128 has been assumed to be a new, grade-separated interchange. If this does not prove feasible, due to minimum-interchange-spacing requirements, the same service, functionally, could be provided by service roadways to existing interchanges.

Package 5

This package was developed to ascertain the traffic-handling ability of a Ring Road that does not incur the potential problems of crossing Minute Man National Historic Park. This Ring Road would be a four-lane, undivided roadway with at-grade intersections, constructed on a new right-of-way. It would follow the

same alignment as in Package 3 (the HATS-Committee Alternative 4), but for the major exception of commencing at an at-grade intersection with Virginia Road in Concord, instead of at Crosby's Corner. Upon entering Bedford, the proposed Ring Road circumvents the Raytheon site before reaching the right-of-way of existing Hartwell Road. It then continues over the Package 3 alignment until reaching its terminus at an at-grade intersection with Hartwell Avenue in Lexington. This package also includes the relocation of Virginia Road described under Alternative 1.

S.5 IMPACT ANALYSIS OF ALTERNATIVE HIGHWAY-NETWORK PACKAGES

The following are broad summaries of the traffic, environmental, and cost impacts associated with each of the packages under consideration. It is impossible, in a few paragraphs, to do justice to the wealth of information presented in sections 3.7.1 through 3.7.3 of Chapter 3 of the full Hanscom Area Traffic Study (CTPS Technical Report 44). While this section attempts to be an accurate condensation of that material, the reader is urged to also read those sections.

It is important to bear in mind that the current and future traffic conditions, shown in Figures S-1 through S-7 and described below, are in terms of morning peak-period travel demand and that there is, therefore, a natural directionality built into the results. This directionality would be expected to approximately reverse itself during the afternoon peak period. In the following impact summaries, the terms "positive impact" and "negative impact" generally refer to a decrease and increase, respectively, in volume/capacity ratio, when comparing 1995 conditions under the package to those under a "no-build" alternative.

Package 1 Impacts

Package 1 has a positive impact on ten of the twenty-three major-roadway segments identified in section 3.7.1.1 of Technical Report 44. These are Route 2A (especially benefited is the section from the Cambridge Turnpike Cutoff to Bedford Road), Routes 4/225 from Brooksbie Road to Hartwell Avenue, Route 62 through Concord and West Bedford (especially benefited is the section from Bedford Street in Concord to Great Road in Bedford), Airport Road, and Virginia Road. Among the major roadway segments, the only two to suffer a negative impact are along Route 2 in Concord, as traffic diverts around Concord Center over Route 2 in order to reach the Ring Road at its western terminus at Crosby's Corner or after exiting the Ring Road at that point.

Support roadways are identified in section 3.7.1.2 of Technical Report 44. Those in Bedford that are positively impacted by Package 1 are a portion of South Road, Summer Street, and Hartwell Road; negatively impacted are the portion of South Road between the proposed Ring Road and Great Road, Ashby/Walsh, Loomis Street, and Bacon Street. In Concord, there are nine support-roadway segments that are positively impacted. These are Lexington Road, the Cambridge Turnpike, Old Bedford Road, Route 126 south of Route 2, Walden Street northbound, Thoreau Street, and Everett Street. Negative impacts are suffered by the

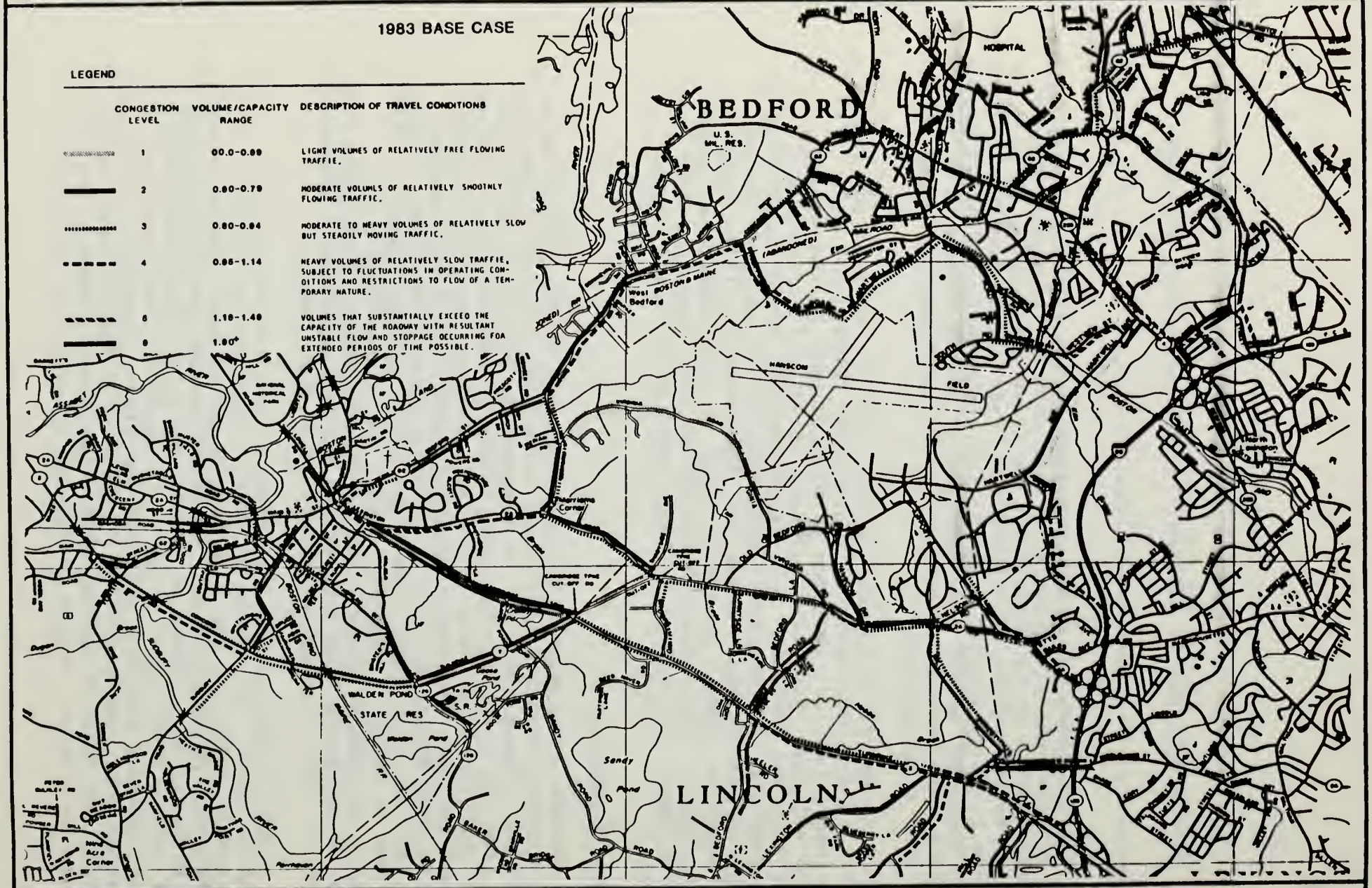
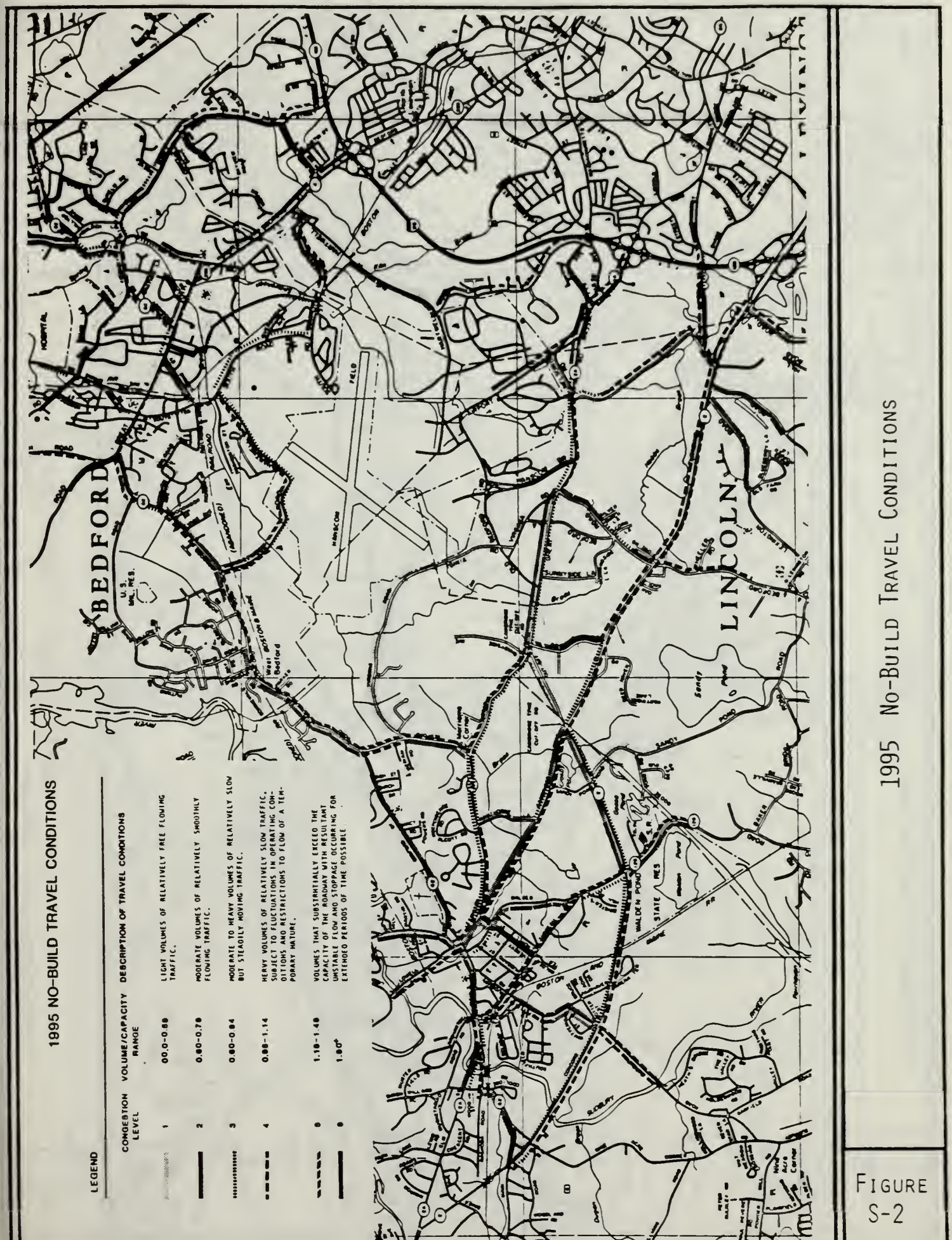


FIGURE S-1

CURRENT TRAVEL CONDITIONS



1995 No-Build Travel Conditions

FIGURE S-2

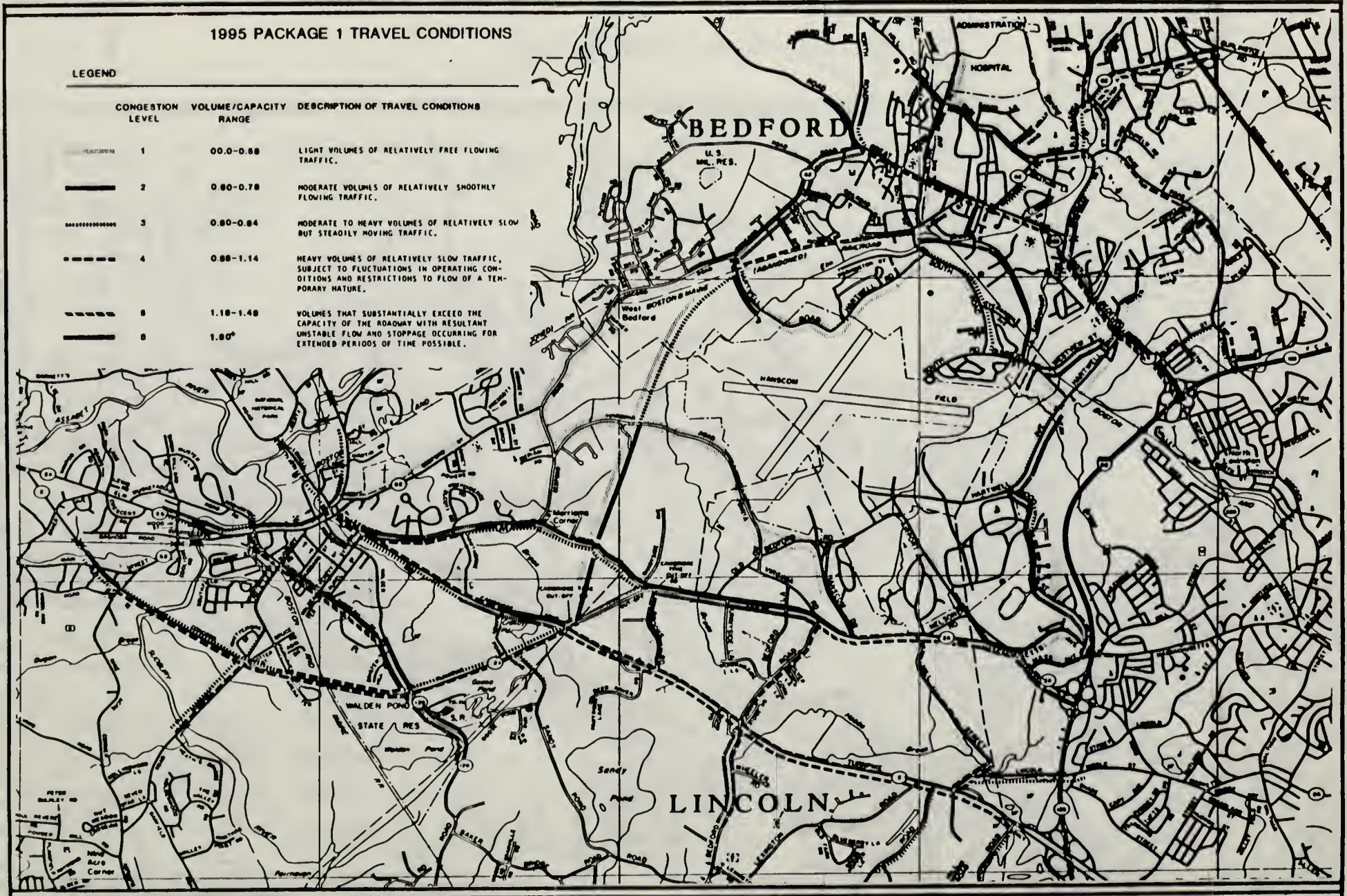


FIGURE S-3

1995 PACKAGE 1 TRAVEL CONDITIONS

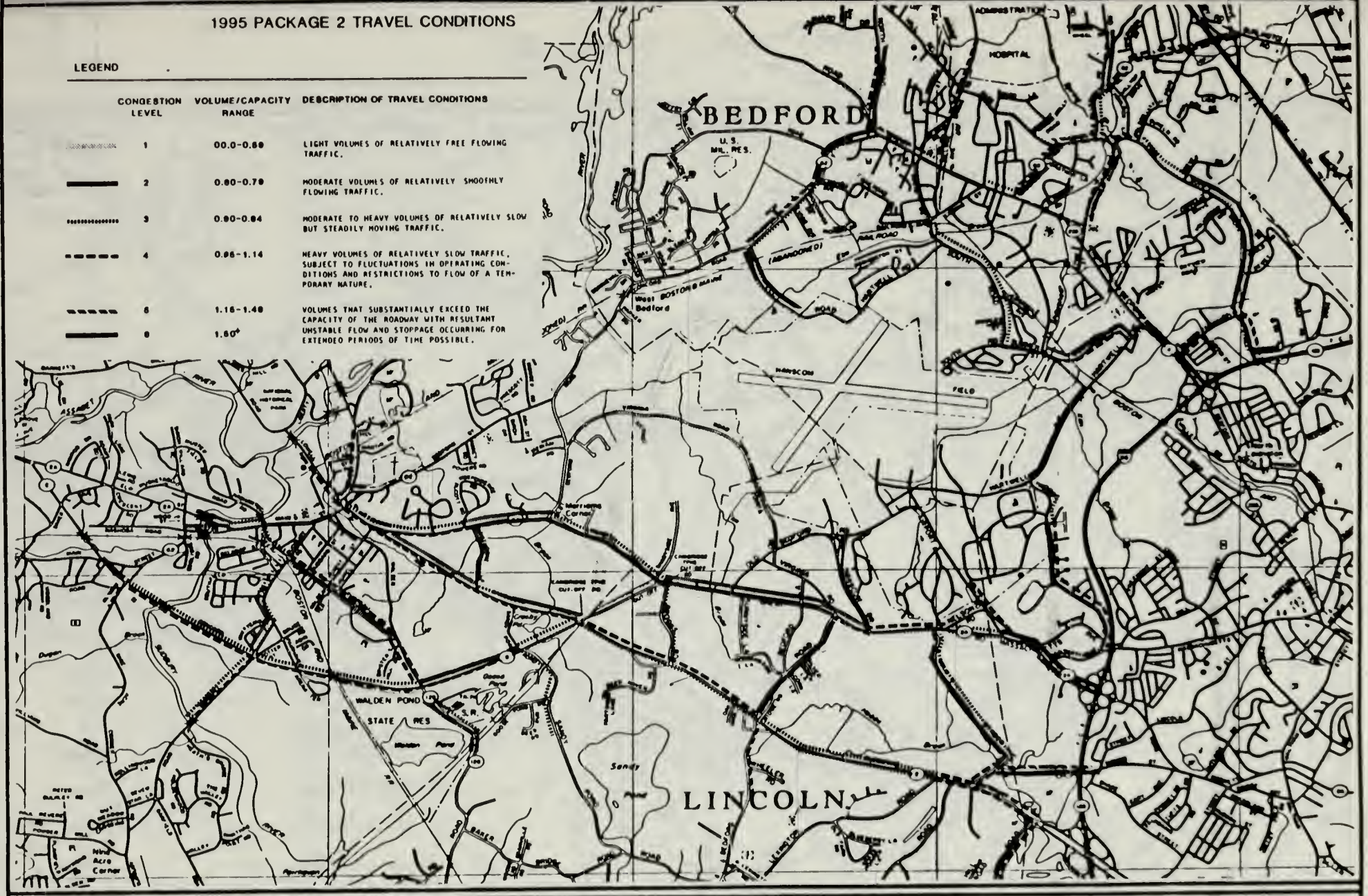


FIGURE S-4

1995 PACKAGE 2 TRAVEL CONDITIONS

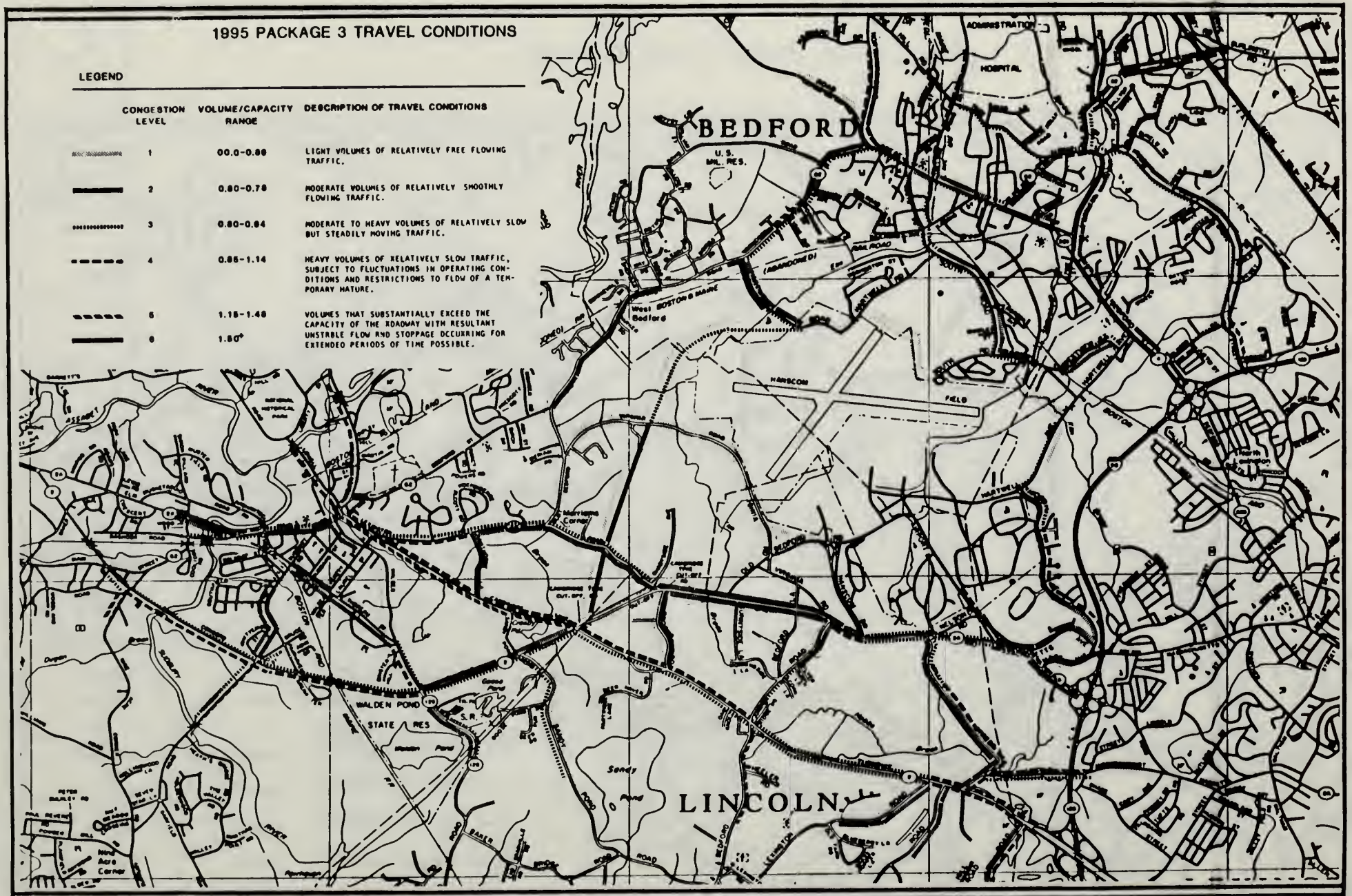


FIGURE S-5

1995 PACKAGE 3 TRAVEL CONDITIONS

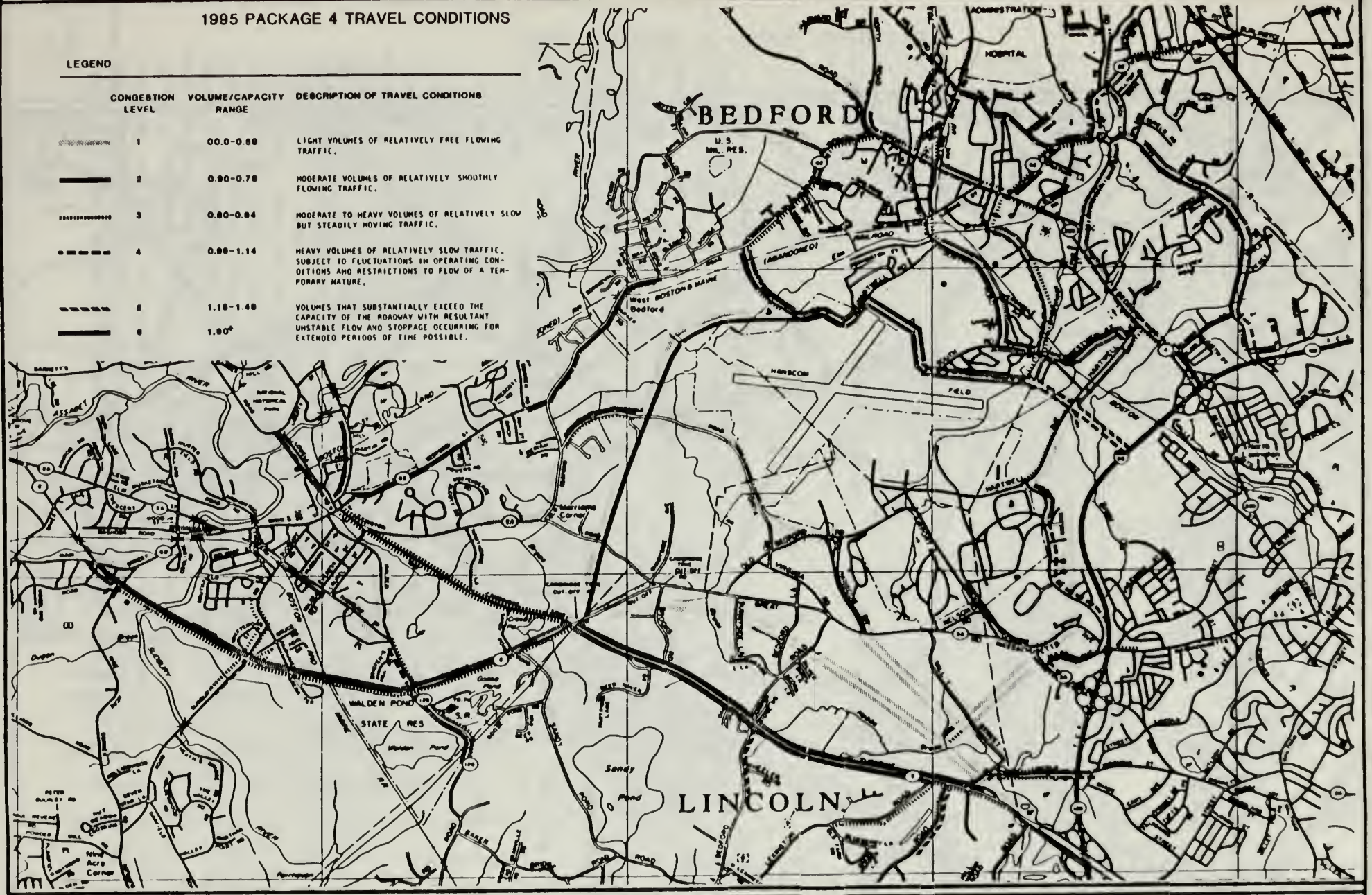


FIGURE S-6

1995 Package 4 Travel Conditions

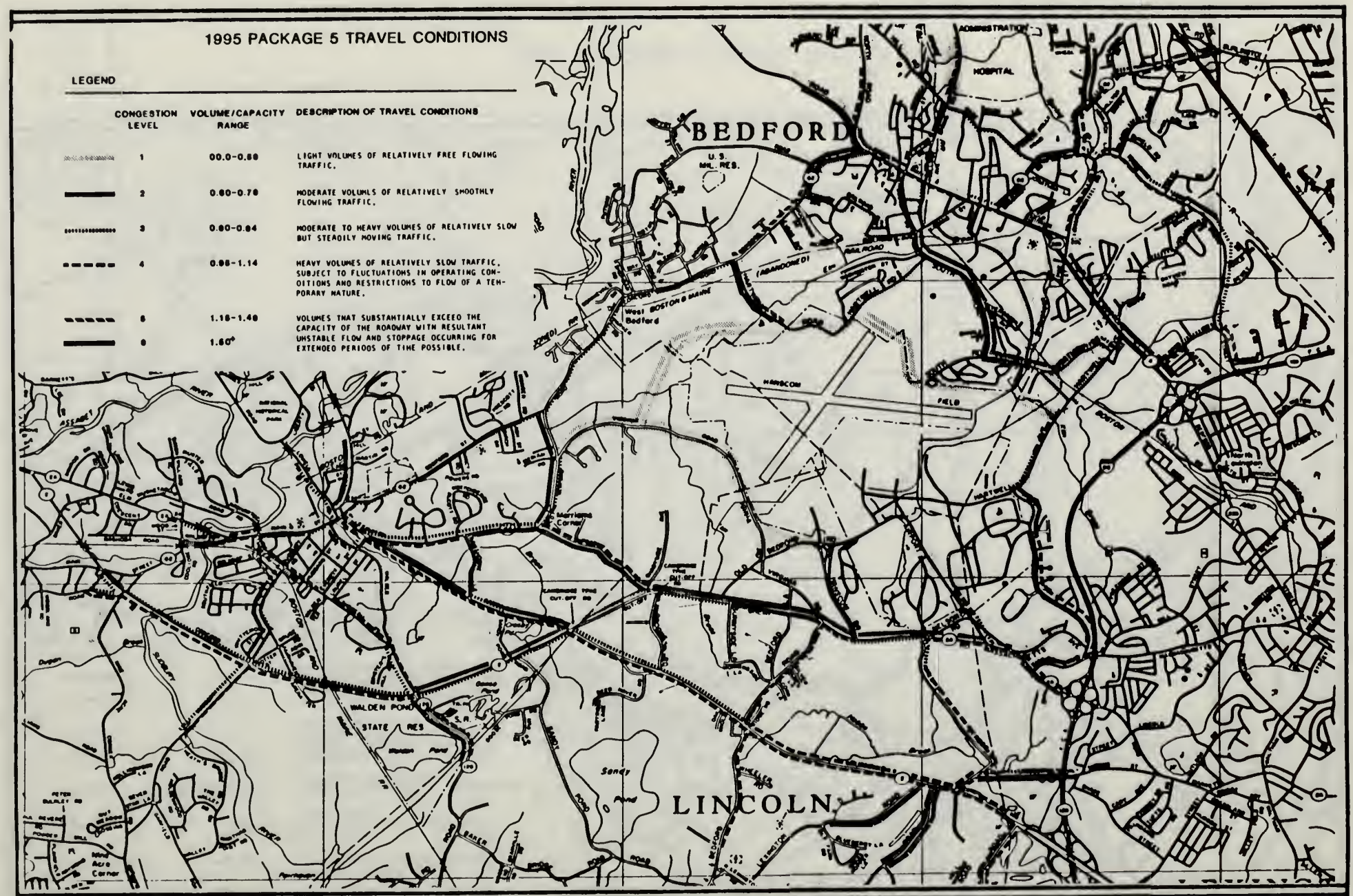


FIGURE S-7

1995 PACKAGE 5 TRAVEL CONDITIONS

Cambridge Turnpike westbound, Sudbury Road, and Walden Street southbound. The only support roadway in Lexington that is positively impacted is the northern section of Hartwell Avenue, while the southern section of Hartwell Avenue and Wood Street are both negatively impacted. In Lincoln, Brooks Road is positively impacted, but Bedford Road, both north and south of Route 2, and Page Road are negatively impacted.

Areas of environmental concern that are impacted by Package 1 are Minute Man National Historic Park (MMNHP), the Bedford Levels, the Runway 11 Clear Zone, the abandoned Boston and Maine Railroad right-of-way, the Bedford Well Fields, and Elm Brook and the Shawsheen River in the vicinity of the northern and southern extensions of Wiggins Avenue, respectively.

Because its ring road alignment is somewhat longer than those of the other packages, Package 1 is slightly more costly in terms of both estimated right-of-way acquisition and construction cost. The tunnel under MMNHP is, however, the major cost consideration associated with Package 1, as with packages 2 through 4.

Package 2 Impacts

Seven major-roadway segments are positively impacted by Package 2. They are along Route 2A (especially benefited is the section from the Cambridge Turnpike Cutoff to Bedford Road), Routes 4/225 from Brooksbie Road to Hartwell Avenue, Route 62 through Concord, and Route 62 from Bedford Street in Concord to Hartwell Road in Bedford. Major roadway segments that suffer negative traffic impacts are Route 2 in Concord, Routes 4/62/225 between Brooksbie Road and Concord Road in Bedford, and Route 62 (westbound) from Great Road to Hartwell Road. The closing of Hartwell Road northeast of the proposed Ring Road is the apparent cause of the negative impact to the latter two roadway segments.

Support roadways in Bedford that are positively impacted by Package 2 are limited to the segment of Carlisle Road north of its intersection with North Road and the segment of South Road between Great Road and Hartwell Road. The latter segment is benefited due to Hartwell Road no longer connecting to Route 62 west of the Raytheon complex. Negative impacts occur on the segment of South Road between Hartwell Road and Summer Street, and on Bacon Street due to traffic moving to and from the Ring Road. Six support roadway segments in Concord are positively impacted, two negatively. The former are Lexington Road between Merriam's Corner and Great Road, Route 126, Walden Street northbound, Thoreau Street, and Everett Street: the latter are Sudbury Road and Walden Street southbound. Again, the only support roadway in Lexington that is positively impacted is the northern section of Hartwell Avenue, while the southern section of Hartwell Avenue and Wood Street are both negatively impacted. In Lincoln, one roadway segment, Brooks Road, is positively impacted and one, Bedford Road south of Route 2, negatively impacted.

Areas of environmental concern that are impacted by Package 2 are Minute Man National Historic Park (MMNHP), the Bedford Levels, the Runway 11 and Runway 23 clear zones, the Bedford Town Forest, and the residential neighborhood bordering Summer Street.

The tunnel under MMNHP is the major cost consideration associated with Package 2.

Package 3 Impacts

Package 3 positively impacts eight major-roadway segments. These segments are located along Route 2A (especially benefited is the section from the Cambridge Turnpike Cutoff to Bedford Road), Routes 4/225 from Brooksbie Road to Hartwell Avenue, Route 62 through Concord, Route 62 from Bedford Street in Concord to Hartwell Road in Bedford, and Airport Road. Major roadway segments that suffer negative impacts are Route 2 in Concord, Routes 4/62/225 between Brooksbie Road and Concord Road in Bedford, and Route 62 (westbound) from Great Road to Hartwell Road.

Support roadways in Bedford that are positively impacted by Package 3 are three in number: the segment of Carlisle Road north of its intersection with North Road, the segment of South Road between Great Road and Hartwell Road (due to the cul-de-sac'ing of Hartwell Road), and Summer Street. Four support-roadway segments in Bedford are negatively impacted: South Road between Hartwell Road and Summer Street, Ashby/Walsh, Loomis Street, and Bacon Street. In Concord, six support-roadway segments are positively impacted, three negatively. Positively impacted are Lexington Road between Merriam's Corner and Great Road, Route 126, Walden Steet northbound, Thoreau Street, and Everett Street. Suffering negative impacts are the Cambridge Turnpike westbound, Sudbury Road, and Walden Street southbound. In Lexington, the northern section of Hartwell Avenue is positively impacted, while the southern section of Hartwell Avenue and its continuation as Wood Street are negatively impacted. Lincoln has one support-roadway segment, Brooks Road, positively impacted and one, Bedford Road south of Route 2, negatively impacted.

Areas of environmental concern that are impacted by Package 3 include Minute Man National Historic Park (MMNHP), the Bedford Levels, the Runway 11 and Runway 23 clear zones, the wetlands bordering the Shawsheen River, and the channel of the Shawsheen River at a new river crossing.

The tunnel under MMNHP is the major cost consideration associated with Package 3.

Package 4 Impacts

Package 4 has the most major roadway segments, eleven, that are positively impacted and the fewest, two, that are negatively

impacted. Positively impacted segments are Route 2 in Concord (where it is upgraded), Route 2A in the vicinity of the Route 128 interchange, Routes 4/225 from Brooksbie Road to the Route 128 interchange, Main Street (Route 62) through Concord, Route 62 from Bedford Street in Concord to Hartwell Road in Bedford, Old Bedford Road, and Virginia Road (both Old Bedford Road and Virginia Road are upgraded). The negatively impacted segments are Routes 4/62/225 from Brooksbie Road to Concord Road and Route 62 westbound from Great Road to Hartwell Road.

Of the support-roadway segments in Bedford, two are positively impacted by Package 4 and five negatively. The former are South Road between Great Road and Hartwell Road, and Summer Street; the latter South Road between Hartwell Road and Summer Street, Wiggins Avenue, Ashby/Walsh, Loomis Street, and Bacon Street. In Concord, eight support roadway segments are positively impacted: Lexington Road from Monument Square to Merriam's Corner, the Cambridge Turnpike, Old Bedford Road between Merriam's Corner and Route 62, Route 126, Walden Street northbound, Thoreau Street, and Everett Street. Four Concord support-roadway segments potentially could be negatively impacted: Nine Acre Corner Road, Sudbury Road both north and south of Route 2, and Walden Street southbound between Thoreau Street and Route 2. In all four cases, the roads act as access to the upgraded Route 2 Expressway or egress from it. Congestion will be minimized only locally at Route 2 where the present intersections will become grade separated. Traffic volumes will increase and only through careful geometric design and expanded capacity will congestion be avoided. Within Lexington, the northern section of Hartwell Avenue and Wood Street are positively impacted, while the southern section of Hartwell Avenue is negatively impacted in the vicinity of the Route 128 Connector. In Lincoln, one support roadway, Old County Road, is positively impacted, but three that are used for Route 2 access or egress have the potential to be negatively impacted. These three are Bedford Road south of the existing alignment of Route 2, Lexington Road, and Page Road. With the increased traffic volumes anticipated, careful geometric design and expanded carrying capacity will be required.

The areas of environmental concern that are impacted by Package 4 are--Minute Man National Historic Park (MMNHP), the Bedford Levels, the Runway 11 and Runway 23 clear zones, the wetlands bordering the Shawsheen River, and the channel of the Shawsheen River at a new river crossing--and, in addition, the wetlands of the Tophet Swamp area.

The cost of the projects that are unique to Package 4 is far beyond that of the Ring Road, which is exceeded by the cost of the upgraded Route 2 alone. As far as the Ring Road itself is concerned, the major cost consideration is the same as for packages 1, 2, and 3; i.e., the tunnel under MMNHP.

Package 5 Impacts

Package 5 has a positive impact on only five major roadway segments, while four segments suffer from a negative impact. The five that are positively impacted are Route 2A between Bedford Road and Marrett Road, Routes 4/225 from Brooksbie Road to Hartwell Avenue, Route 62 from Bedford Street to Hartwell Road, Airport Road, and Virginia Road. Negatively impacted are Routes 4/62/225 between Brooksbie Road and Concord Road in Bedford, Route 62 through Concord, and Route 62 westbound from Great Road to Hartwell Road in Bedford.

Support-roadway segments in Bedford that are positively impacted by Package 5 are only two in number: South Road between Great Road and Hartwell Road (again due to the cul-de-sac'ing of Hartwell Road) and Summer Street. There are also two that are negatively impacted: South Road between Hartwell Road and Summer Street, and Bacon Street. In Concord, Lexington Road eastbound between Merriam's Corner and Great Road is the only support-roadway segment positively impacted, while Lexington Road westbound between Merriam's Corner and Great Road, Old Bedford Road between Merriam's Corner and Route 62, Walden Street between Thoreau Street and Main Street, Thoreau Street, and Everett Street are all negatively impacted. In Lexington, the northern section of Hartwell Avenue is positively impacted, while the southern section of Hartwell Avenue and its continuation as Wood Street are negatively impacted. In Lincoln, no support roadways are positively impacted, but Bedford Road north of Route 2 and Old County Road are negatively impacted.

The areas of environmental concern that are impacted are fewer in number for Package 5 than for any of the other packages. They are the Runway 11 and Runway 23 clear zones, the wetlands bordering the banks of the Shawsheen River, and the channel of the Shawsheen River at a new river crossing. The reduction in length of the Ring Road has the direct benefit of avoiding the concerns associated with tunneling under Minute Man National Historic Park (MMNHP) and with crossing the Bedford Levels.

The reduction in length of the Ring Road in Package 5 also has the positive effect of reducing the cost of right-of-way acquisition and construction. The major cost reduction results from the elimination of the tunnel under MMNHP.

Summary of Package Impacts

Package 4 provides the most traffic flow improvements, followed in order by Package 1, Packages 2 and 3 (which provide similar levels of improvement), and Package 5 (which provides far fewer benefits than any of the others). Package 4 also impacts the largest number of environmentally sensitive areas, due to its far more extensive system improvements. Packages 1, 2, 3, and 5 follow in terms of lessening environmental impact. Cost of

implementation of the five packages also falls in that same order. Package 4, again because of its extensive nature, has the highest cost, with Package 1, Package 2, Package 3, and Package 5 each involving a lesser cost.

It should be pointed out that a simple ranking is not the ultimate way in which the merits or demerits of alternative packages are to be compared. Some positive aspects are far more important than others and so must be given greater weight in the decision process. The same is true, of course, for negative impacts.

S.6 SOCIOECONOMIC AND TRAVEL TRENDS IN THE STUDY AREA

While not all of the work-trip information from the 1980 U. S. Census is available at this time, it is possible to determine that just under 50 percent of employed residents work within the study area, filling approximately 40 percent of the study area's jobs. For the approximately 60 percent of workers who commute into the area, the dominant direction of travel is from the north, with almost 10 percent coming from as far away as southern New Hampshire. This northern orientation of commuter traffic is expected to continue into the future, as is the area's role as a net importer of work trips.

Employment has been growing, and will continue to grow, in the study area. Some new jobs have been filled through increased participation of study-area residents (primarily married women) in the labor force. However, the vast majority of new jobs will be filled by workers commuting into the area. This trend is and will continue to be contributed to by the fact that the area houses a large white-collar population, while a substantial number of new jobs are and will be in the manufacturing category.

Since both residents and non-residents are heavily dependent on the automobile as their commuting mode, it is not surprising that the growth in employment has resulted in an increase in auto traffic. As future growth occurs, it is to be expected that this trend will continue.

The study area's population, which grew very rapidly during the 1950's and 1960's, has stabilized over the past decade.

All four study-area communities are expected to have a stable population through the year 1995, but this population will be housed in a greater number of dwelling units (i.e., household size will decrease). Employment in all four communities is expected to grow substantially. This growth ranges from a low of 16 percent for Lincoln to a high of 41 percent for Concord.

Table S-1

Community Population and Employment

Population			Employment		
Community	1982	1995	1982	Original 1995	Revised 1995
Bedford	13,067	13,100	12,266	21,300	28,000
Concord	16,293	16,300	11,308	10,700	16,000
Lexington	29,479	29,500	18,202	19,500	25,300
Lincoln	7,098	7,100	1,589	1,600	1,850

The population and employment trends will result in increased commutation into the Traffic Impact Area by residents of communities throughout eastern Massachusetts and southern New Hampshire. The impact will be felt particularly during the morning and afternoon peak periods.

An analysis of current traffic conditions was conducted in terms of intersection congestion and high accident locations. The following such problems were identified.

Route 2 Corridor

The Route 2 corridor is marked by high traffic volumes that result in traffic congestion and accidents. These problems reach a peak at the intersection of Route 2 and the Cambridge Turnpike Cutoff (also known as Crosby's Corner) and at the intersection of Route 2 and Bedford Road. These two intersections have the most severe safety problems in the study area. Crosby's Corner also has extremely long traffic delays on the Route 2 approaches during peak hours.

Hartwell Avenue Area

The Hartwell Avenue area in Lexington, especially the intersection of Hartwell Avenue and Bedford Street (Routes 4/225), has severe congestion and safety problems. Ranking close behind the Hartwell Avenue/Bedford Street intersection is the intersection of Hartwell Avenue and Maguire Road. The Hartwell Avenue/Bedford Street intersection is marked by extremely long queues on several of its approaches, as well as by a high accident rate. The intersection of Hartwell Avenue and Maguire Road has long delays on its Maguire Road approach and a high accident rate.

The Great Road (Routes 4/62/225), Bedford

The section of the Great Road in Bedford between North Road and its intersection with Shawsheen Road is subject to both congestion and safety problems. The signalized intersections of Great Road and South Road and Great Road and Shawsheen Road function with less congestion than most of the uncontrolled intersections, but still have safety problems.

Route 2A

Route 2A in Lincoln and Lexington between Crosby's Corner and Routes I-95/128 has congestion and safety problems, mainly at uncontrolled intersections. At intersections such as Route 2A and Hanscom Drive and Route 2A and the Cambridge Turnpike Cutoff, side street traffic faces intolerable delays, except for those drivers who are willing to enter gaps in the Route 2A traffic that are considerably smaller than is considered safe for such entry.

Route 62

Route 62 in Concord and Bedford from Concord Center to Bedford Center has congestion and safety problems in Concord Center at Monument Square and in Bedford at Hartwell Road. Problems at other locations along this stretch are less serious.

Local Streets

While traffic congestion and safety problems do exist on local streets, they are less serious than those that have been cited on the major state highways, except for the problems on Hartwell Road and South Road in Bedford.